WHAT IS CLAIMED IS:

1. A microneedle device for transporting fluid through a surface of a biological barrier, the device comprising:

(a) a fluid transport configuration including:

(i) a substrate having a substantially planar surface; and

(ii) a plurality of microneedles projecting from said planar surface, each of said microneedles having a cutting edge, a penetrating tip, a base area and a height;

(b) an abutment member having at least one abutment surface for abutting the biological barrier, said abutment member being mechanically connected to said fluid transport configuration; and

(c) a displacement device operationally connected to said abutment member, said displacement device configured for generating a relative lateral sliding movement between the surface of the biological barrier and said fluid transport configuration in a sliding direction of said microneedles,

wherein said microneedles are arranged so that a leading one of said microneedles defines an effective area which is void of another of said microneedles, said effective area being defined as an area marked out by translating said base area of said leading microneedle, by said height of said leading microneedle, in a direction opposite to said sliding direction.

2. The device of claim 1 wherein a spacing of said microneedles in said sliding direction is at least the square root of 2 times a closest neighbor spacing.

3. The device of claim 1 wherein:

(a) said abutment member is configured as a suction cup, said fluid transport configuration being disposed in said suction cup; and

(b) said displacement device includes a suction arrangement in fluid connection with said suction cup, said suction arrangement being configured for generating suction for pulling the surface of the biological barrier into said suction cup, said suction cup and said fluid transport configuration being configured such that the surface of the biological barrier slides across said planar surface in said sliding direction.

4. The device of claim 3, wherein:

(a) said abutment surface lies on a first plane;

(b) said surface of said substrate lies on a second plane; and

(c) said first plane is oblique to said second plane.

5. The device of claim 3, wherein said suction cup has an internal surface which is axis asymmetrical.

6. The device of claim 3, wherein said suction cup includes a side trough in fluid connection with said suction arrangement, said suction arrangement and said side trough being configured such that, after the surface of the biological barrier has made contact with said microneedles, the biological barrier is pulled into said side trough thereby pulling the surface of the biological barrier across said surface of said substrate.

7. The device of claim 3, wherein said displacement device mechanically links said abutment member and said fluid transport configuration, said displacement device defining a path of movement of said fluid transport configuration relative to said abutment surface, at least part of said path of movement having a non-zero component parallel to said surface of said substrate.

8. The device of claim 3, wherein said suction arrangement includes a suction plunger, said suction arrangement being configured for generating suction for pulling the surface of the biological barrier into said suction cup with a single one-directional movement of said suction plunger to a retracted position in said suction arrangement.

9. The device of claim 8, wherein said suction arrangement includes a locking mechanism for retaining said suction plunger in said retracted position.

10. The device of claim 3, further comprising a fluid injection plunger arrangement having a fluid plunger, said fluid injection plunger arrangement being in fluid connection with said fluid transport configuration, such that depressing said fluid plunger delivers the fluid via said fluid transport configuration.

11. The device of claim 10, wherein said fluid injection plunger arrangement is disposed within said suction arrangement.

12. The device of claim 10, further comprising a priming port in fluid connection with said fluid injection plunger arrangement, said priming port being configured for providing a fluid connection between an external supply of the fluid and said fluid injection plunger arrangement during filling of said fluid injection plunger arrangement with the fluid.

13. The device of claim 10, wherein said fluid injection plunger arrangement has a movement restriction arrangement configured to prevent negative pressure within said suction cup from pulling down said fluid plunger.

14. The device of claim 1, wherein at least one of said fluid transport configuration and said abutment member are configured such that, a leading one of said rows of said microneedles contacts the biological barrier prior to a trailing one of said rows of said microneedles contacting the biological barrier.

15. The device of claim 1, wherein said displacement device is mechanically connected to said abutment member and said fluid transport configuration, said displacement device defining a rotational path of movement of said fluid transport configuration relative to said abutment member.

16. The device of claim 15, wherein said rotational path of movement is about an axis substantially parallel to the initial orientation of the surface of the biological barrier.

17. A microneedle device for transporting fluid across a biological barrier, the device comprising:

(a) a fluid transport configuration including:

(i) a substrate having a substantially planar surface; and

(ii) a plurality of microneedles projecting from said surface, each of said microneedles having a penetrating tip, a cutting edge, a base area and a height;

(b) an abutment member having at least one abutment surface for abutting the biological barrier; and

(c) a displacement device mechanically linking said abutment member and said fluid transport configuration, said displacement device defining a path of movement of said fluid transport configuration relative to said abutment surface, at least part of said path of movement having a non-zero component parallel to said planar surface;

wherein said microneedles are arranged so that a leading one of said microneedles defines an effective area which is void of another of said microneedles, said effective area being defined as an area marked out by translating said base area of said leading microneedle, by said height of said leading microneedle, in a direction opposite to said non-zero component.

18. The device of claim 17, wherein a spacing of said microneedles in said direction is at least the square root of 2 times a closest neighbor spacing.

19. A microneedle device for transporting fluid across a biological barrier, the device comprising: a substrate defining a substantially planar surface; and a plurality of microneedles projecting from said surface, each of said microneedles having a penetrating tip, a cutting edge,

a base area and a height, each of said microneedles having a base-to-tip vector defined as a vector from a centroid of said base area to a centroid of said penetrating tip, said microneedles being asymmetrical such that said base-to-tip vector is non-perpendicular to said surface, a direction parallel to a projection of said base-to-tip vector on to said planar surface being taken to define a penetration direction, said microneedles being arranged so that a leading one of said microneedles defines an effective area which is void of another of said microneedles, said effective area being defined as an area marked out by translating said base area of said leading microneedle, by said height of said leading microneedle, in a direction opposite to said penetration direction.

20. The device of claim 19, wherein a spacing of said microneedles in said penetration direction is at least the square root of 2 times a closest neighbor spacing.

21. A microneedle device for transporting fluid through a surface of a biological barrier, the device comprising:

(a) a fluid transport configuration including:

(i) a substrate having a surface; and

(ii) a plurality of microneedles projecting from said surface of said substrate, each of said microneedles having a penetrating tip and a cutting edge, said microneedles being arranged in a plurality of rows;

(b) an abutment member having at least one abutment surface for abutting the biological barrier, said abutment member being mechanically connected to said fluid transport configuration; and

(c) a displacement device operationally connected to said abutment member, said displacement device configured for generating a relative lateral sliding movement between said fluid transport configuration and the surface of the biological barrier, at least one of said fluid transport configuration and said abutment member being configured such that, a leading one of said rows of said microneedles contacts the biological barrier prior to a trailing one of said rows of said microneedles contacting the biological barrier.

22. The device of claim 21, wherein said displacement device mechanically links said abutment member and said fluid transport configuration, said displacement device defining a path of movement of said fluid transport configuration relative to said abutment surface, at least part of said path of movement having a non-zero component parallel to said surface of said substrate.

23. The device of claim 21, wherein:

(a) said abutment member is configured as a suction cup, said fluid transport configuration being disposed in said suction cup; and

(b) said displacement device includes a suction arrangement in fluid connection with said suction cup, said suction arrangement being configured for generating suction for pulling the surface of the biological barrier into said suction cup thereby generating said relative lateral sliding movement between said fluid transport configuration and the surface of the biological barrier.

24. The device of claim 23, wherein:

(a) said abutment surface lies on a first plane;

(b) said surface of said substrate lies on a second plane; and

(c) said first plane is oblique to said second plane.

25. The device of claim 23, wherein said suction cup has an internal surface which is axis asymmetrical.

26. The device of claim 25, wherein said suction cup includes a side trough in fluid connection with said suction arrangement, said suction arrangement and said side trough being configured such that, after the surface of the biological barrier has made contact with said microneedles, the biological barrier is pulled into said side trough thereby pulling the surface of the biological barrier across said surface of said substrate.

27. A microneedle device for transporting a fluid through a surface of a biological barrier, the device comprising:

(a) a fluid transport configuration including:

(i) a substrate having a surface; and

(ii) a plurality of microneedles projecting from said surface;

(b) an abutment member configured as a suction cup having at least one abutment surface for abutting the biological barrier, said fluid transport configuration being disposed in said suction cup; and

(c) a displacement device including a suction arrangement in fluid connection with said suction cup, said suction arrangement including a suction plunger, said suction arrangement being configured for generating suction for pulling the surface of the biological barrier into said suction cup with a single one-directional movement of said suction plunger to a retracted position in said suction arrangement.

28. The device of claim 27, wherein each of said microneedles has a cutting edge and a penetrating tip.

29. The device of claim 27, wherein said suction arrangement includes a locking mechanism for retaining said suction plunger in said retracted position.

30. The device of claim 27, further comprising a fluid injection plunger arrangement having a fluid plunger, said fluid injection plunger arrangement being in fluid connection with said fluid transport configuration, such that depressing said fluid plunger delivers the fluid via said fluid transport configuration.

31. The device of claim 30, wherein said fluid injection plunger arrangement is disposed within said suction arrangement.

32. The device of claim 30, further comprising a priming port in fluid connection with said fluid injection plunger arrangement, said priming port being configured for providing a fluid connection between an external supply of the fluid and said fluid injection plunger arrangement during filling of said fluid injection plunger arrangement with the fluid.

33. The device of claim 30, wherein said fluid injection plunger arrangement has a movement restriction arrangement configured to prevent negative pressure within said suction cup from pulling down said fluid plunger.

34. A microneedle device for transporting fluid through a surface of a biological barrier, the device comprising:

(a) a fluid transport configuration including:

(i) a substrate having a surface; and

(ii) a plurality of microneedles projecting from said surface of said substrate, each of said microneedles having a penetrating tip and a cutting edge;

(b) an abutment member configured as a suction cup, said fluid transport configuration being disposed in said suction cup; and

(c) a displacement device including a suction arrangement in fluid connection with said suction cup, said suction arrangement being configured for generating suction for pulling the surface of the biological barrier into said suction cup thereby generating a relative lateral sliding movement between said fluid transport configuration and the surface of the biological barrier.

35. A microneedle device for transporting fluid through a surface of a biological barrier, the device comprising:

(a) a fluid transport configuration including:

(i) a substrate having a surface; and

(ii) a plurality of microneedles projecting from said surface;

(b) an abutment member having at least one abutment surface for abutting the biological barrier; and

(c) a displacement device mechanically connected to said abutment member and said fluid transport configuration, said displacement device defining a rotational path of movement of said fluid transport configuration relative to said abutment member.

36. The device of claim 35, wherein said rotational path of movement is about an axis substantially parallel to the initial orientation of the surface of the biological barrier.

37. The device of claim 35, wherein each of said microneedles has a cutting edge and a penetrating tip.